REPORT

GEOTECHNICAL INVESTIGATION
FIRE STATION NUMBER 17
San Jose, California

Prepared for
City of San Jose
Department of Public Works
City Facilities Architectural Services
675 N. First Street, Room 300
San Jose, CA 95112

February 25, 2005

URS Corporation
55 South Market Street, Suite 1500
San Jose, California 95113

URS

February 25, 2005
Project No. 28649627

City of San Jose
Department of Public Works
City Facilities Architectural Services
675 North First Street, Room 300
San Jose, California 95112

Attention: Mr. Taghi Saadati, S.E.
Section Manager

Subject: Geotechnical Investigation
Proposed Fire Station Number 17
Blossom Hill Road
San Jose, California

Ladies/Gentlemen:

We have investigated the conditions at the site of the proposed Fire Station Number 17 in San Jose, California. The purpose of the investigation was to develop design recommendations regarding foundation support, as well as opinions regarding other geotechnical aspects of site development. Two exploratory borings were completed at the site to study the subsurface conditions.

The accompanying report presents opinions and design recommendations which have been based on the results of field exploration and laboratory testing, as well as engineering judgment and experience with similar projects.

We thank you for the opportunity to be of service on this project. If any questions should arise regarding the contents of this report, or if we can be of further service, please contact our office at your convenience.

Sincerely,

Jose I. Landazuri, G.E. 501
Project Manager

cc: Addressee (5)

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Figures

Appendices

This report presents the results of our geotechnical investigation for the proposed Fire Station Number 17 to be constructed at the intersection of Blossom Hill Road and Coniston Way in San Jose, California. Included in this report are the logs of two borings completed for this investigation, and our geotechnical conclusions and recommendations for design and construction.

1.1 PROJECT DESCRIPTION

We understand that the new fire station will consist of a two-story structure with slab-on-grade floors, and with overall plan dimensions of about 50 feet by 90 feet with adjacent vehicular parking. Portland cement concrete pavement for fire vehicle parking and access is planned. Although no structural plans are currently available, we have assumed that the proposed structure will be relatively light.

1.2 SCOPE OF SERVICES

Our scope of services included field exploration, engineering analyses, and preparation of this report. Specifically our work included the following tasks:

1.2.1 Review of Geological Data

This part of our scope was completed to provide an evaluation of potential geologic hazards at the project site. Geologic information reviewed for the project included:

- Geologic maps and reports published by the U.S.Geological Survey;
- Geologic maps and reports published by the California Geological Survey;
- Alquist-Priolo zone fault maps published by the California Geological Survey;
- On-line seismic hazard zone maps from the California Geological Survey; and
- On-line geologic hazard zone maps from Santa Clara County.

1.2.2 Field Exploration

The field exploration included logging two exploratory borings completed at the site to depths of 25½ to 50½ feet. URS also coordinated buried utility locations and clearance with City representatives and Subdynamics, a private utility locating service.

1.2.3 Laboratory Tests

Laboratory tests were performed to estimate the engineering properties of the subsurface soils encountered in the borings. Specifically, the tests included moisture content, dry density, unconfined compressive strength, R-value and plasticity testing.

1.2.4 Engineering Analyses and Recommendations

We developed geotechnical recommendations for the proposed facility as follows:

- Feasible foundation types, depths and design parameters, including resistance to lateral loads;
- Foundation settlement estimates;
- Site seismicity, including UBC Site Coefficients;
- Support of slab-on-grade floors;
- Recommendations for earthwork, site grading, and underground utility backfilling;
- Structural pavement sections for fire truck access and parking; and
- Potential for earthquake induced soil liquefaction.

1.2.5 Report

Preparation of this geotechnical report summarizing our findings.

2.1 SITE CONDITIONS

Fire Station Number 17 will be located at the northeast corner of the intersection of Blossom Hill Road and Coniston Way in San Jose. The site currently supports a one-story residential structure, a swimming pool, low lying surface vegetation and trees.

2.2 SUBSURFACE CONDITIONS

2.2.1 Field Exploration

The subsurface conditions were investigated by drilling two exploratory borings (Borings B1 and B2) at the approximate locations shown on Figure 2. The locations of the borings were determined in part by the access restrictions to portions of the site. A detailed discussion of the techniques used for the subsurface investigation is presented in Appendix A. The depths of these two borings were 25½ and 50½ feet below the existing ground surface (bgs). Figure A-1 presents the Unified Soil Classification System, as well as guidelines summarizing soil consistency and relative density used in preparation of the boring logs. Figure A-2 illustrates the notation used for the types of samples and methods of advancing them. Comprehensive descriptions of the soils encountered at each location are presented on the Logs of Borings in Figures A-3 and A-4. The soil conditions encountered are summarized in Section 2.2.3.

2.2.2 Laboratory Testing

Soil samples were carefully sealed in the field and returned to our laboratory for testing. Soil classifications made in the field were verified in the laboratory after further examination and testing. Laboratory tests were performed on selected soil samples. These tests include water content, dry density, grain size analyses, unconfined compressive strength, and R-value. The results of these tests are presented at the corresponding sample locations on the Log of Borings, Figures A-3 and A-4.

Grain size analyses were performed on selected soil samples; the results of these tests are presented in Figure A-5. Atterberg limits (liquid and plastic limits) tests for fine grained soil samples were performed; the results of these tests are presented in Figure A-6. An R-value test was performed on a selected bulk sample at the project site; the results of this test are presented in Figure A-7. A more comprehensive discussion of the laboratory testing program is presented in Appendix A.

2.2.3 Soil Conditions

Underlying approximately 2 to 3 inches of grass and roots in both borings is a layer of stiff to hard, dark brown to gray, medium plasticity clay; this layer extends to a depth of about 8 feet (Boring 2) below ground surface (bgs) and 12 feet bgs (Boring 1).

Below depths of 8 and 12 feet, predominantly medium dense to dense gravels were encountered to about 18 feet bgs, underlain by stiff lean clay to depths of 20 to 23 feet where dense to very dense gravels were encountered to a depth of 33 feet. Boring B1 encountered stiff lean clay underlying the gravel layer to a depth of about 45 feet. Very dense gravel was encountered at about 45 feet bgs, extending to 50½ feet, the terminal depth of boring B-1.

2.2.4 Groundwater

Groundwater was not encountered in either boring during drilling before the rotary wash method was used. The rotary wash method of drilling began at a depth of 15 feet bgs in Boring B-1. California Division of Mines and Geology maps show the groundwater depth in the general site area ranging from 10 to 20 feet in depth.

2.3 GEOLOGIC SETTING

Fire Station Number 17 is located within the southwestern portion of the Santa Clara Valley, an alluvial basin located between the Santa Cruz Mountains to the southwest and the Diablo Range to the northeast. The Santa Clara Valley is located between the active San Andreas fault to the west, and the Hayward and Calaveras faults to the east. Each of these faults has produced damaging earthquakes during historic time. The valley margins are marked by belts of active thrust faults; the Foothills fault system to the southwest and the East Valley thrusts (Southeast Extension of the Hayward fault) to the northeast (Fenton and Hitchcock, 2002).

The Foothills fault system is a series of southwest-dipping thrust faults located along the range front of the Santa Cruz Mountains (Bürgmann et al., 1994). The Monte Vista-Shannon and Sargent faults are the main active faults in the Foothills thrust system. The Monte Vista-Shannon thrust is approximately 41 km long and dips at a moderate angle to the southwest, merging with the San Andreas fault at depth. The Sargent fault is approximately 56 km long and merges with the San Andreas fault near Loma Prieta.

The East Valley thrusts are a series of northeast-dipping thrust faults that mark the junction between the southern end of the Hayward fault and the southern and central segments of the Calaveras fault. These faults are relatively short, less than 30 km long, and appear to merge with the Hayward and Calaveras faults at relatively shallow depths (Jones et al., 1994). Recent geologic and geomorphic investigations along both the Foothills and East Valley thrust systems indicate that they are active and may be capable of generating damaging earthquakes (Hitchcock and Kelson, 1999; Fenton and Hitchcock, 2002, Cleary and Hoexter, 2004).

The geology at Fire Station Number 17 has been mapped by Knudsen et al. (2000) as latest Pleistocene alluvial fan deposits. The preliminary geologic map of the Los Gatos quadrangle (Dibblee, 1978) maps the area as Quaternary older alluvium. These materials are described as interbedded sand, gravel and clay.

2.4 GEOLOGIC HAZARDS

2.4.1 Geologic Resources

Resources consulted for geologic hazard assessments included:

- Geologic maps of the California Division of Mines and Geology (now California Geological Survey).
- Alquist-Priolo Earthquake Fault Zone maps.
- On-line seismic hazard zone maps from the California Geological Survey.
- On-line geologic hazard zone maps from Santa Clara County.
- Preliminary maps of Quaternary deposits and liquefaction susceptibility, nine-county San Francisco Bay region: A digital database, U.S. Geological Survey, Open-File Report 00-444.

2.4.2 Fault-Related Ground Rupture

Surface fault rupture tends to recur along existing fault traces. The highest potential for surface faulting is along existing fault traces that have had Holocene fault displacement. The California Geological Survey (formerly Division of Mines and Geology) has produced maps showing Alquist-Priolo Earthquake Fault Zones along faults with known Holocene activity that pose a potential surface faulting hazard. There are no Alquist-Priolo zones mapped in the vicinity of the site. In addition, the City of San Jose Fault Hazard Map does not identify any fault hazard zones in the project area. The closest active fault to the site is the Monte Vista-Shannon fault zone indicated as a fault rupture hazard zone on the Santa Clara County Geologic Hazard zone maps (2002). The project site is located about 2 miles north-northeast of the Monte Vista-Shannon fault zone. The San Andreas fault is located about 7.8 miles southwest of the site. The potential for surface fault rupture at the site is considered remote.

2.4.3 Liquefaction

The project site is located in an area shown with a "low" liquefaction potential on the liquefaction susceptibility map (Knudsen, et al, 2000) as well as on the seismic hazard zone map of the Los Gatos quadrangle (CGS, 2004). Section 2.5 presents site specific information regarding liquefaction potential.

2.4.4 Flooding

Flooding at the site is not a potential hazard. The site is not located within the FEMA 100-year flood zone (*i.e.*, the region that has approximately a 1% annual probability of flooding).

2.4.5 Landslides

Due to the relatively flat topography at the site, landsliding is not a hazard.

2.4.6 Lateral Spreading

There are no slopes or creek channels near the site. Therefore, lateral spreading is not a hazard.

2.5 LIQUEFACTION POTENTIAL

Soil liquefaction is a phenomenon in which saturated, cohesionless soils lose their strength due to the build-up of excess porewater pressure during cyclic loading such as that induced by earthquakes. Soils most susceptible to liquefaction are clean, loose, fine-grained sands, and silts which are saturated.

The potential for liquefaction at the project site was evaluated using a semi-empirical method consistent with the recommendations of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils (NCEER-97-0022) and the CDMG Special Publication 117. Characteristics of the design earthquake and the exploratory data were input into a customized spread sheet to analyze the liquefaction potential.

The design earthquake event for the liquefaction analysis is based on an interactive Probablistic Seismic Hazards Mapping program provided by California Geological Survey, Department of Conservation. This is a ground motion based on the San Andreas fault with $M_W = 7.9$ at a distance of 7.8 miles. It was apparent during our liquefaction analysis that the San Andreas fault, due to the much larger earthquake magnitude, governed from a liquefaction potential standpoint. Therefore, we analyzed the potential for liquefaction using a peak ground acceleration (PGA) of 0.50g and a M_W of 7.9. Based on our analysis (Appendix B), it is our opinion that liquefaction potential at this site is low.

3.1 GENERAL

The principal geotechnical considerations at the site are the existing residential structure and associated facilities, the placement of engineered fill to backfill excavations, and the medium expansive nature of the near surface native soils which generally consists of stiff to hard clay, and have a medium potential for shrinkage and swelling when subjected to fluctuations in moisture content. These geotechnical considerations form the basis for the recommendations which follow.

4.1 FOUNDATION SUPPORT

4.1.1 Spread Footing Design

In general, the existing native soils are suitable for shallow, spread and continous footings. However, the demolition and removal of existing structures will require the placement of engineered fill over portions of the site. Because of the existing swimming pool, the required fill could be up to 10 feet deep. Provided the engineered fill is constructed in accordance with our recommendations, it is recommended that continous and spread footings be supported on native soils or on new non-expansive engineered fill. The bottom of footings should extend to a minimum embedment depth of 2 feet below the lowest adjacent finished grade. Design bearing pressures of 2,000 pounds per square foot (psf) for dead loads, 3,000 psf for dead plus live loads, and 4,000 psf for all loads including wind or seismic, are recommended for footings bearing on the recommended native soils or engineered fill.

It is recommended that the Geotechnical Engineer observe the site grading and test the compaction of the new fill, and observe the bottom of the footings before any steel reinforcement or concrete is placed.

4.1.2 Estimated Settlement

It is estimated that post-construction total and differential settlements of spread footings designed in accordance with our recommendations will not exceed about ¾ inch and ½ inch, respectively.

Because of the larger fill depths needed to backfill the pool area, footings could bear across native soils and deep fills. We recommend that the footings in the pool area, and 10 feet beyond, be constructed with additional longitudiual reinforcement. As a minimum, the longitudiual reinforcement should be placed at the top and bottom of the footing.

4.1.3 Foundation Resistance to Lateral Loads

Resistance to transient lateral loads from wind or earthquakes can be developed by friction between the bottom of the footings and the soil, and passive resistance on the front face of the footings. An ultimate coefficient of friction of 0.35 should be used between the bottom of the footings and underlying soil, not to exceed an adhesion of 800 psf, provided that the footings are cast neat against the engineered fill. Ultimate passive resistance of the soil may be estimated using an equivalent fluid weight of 350 pounds per cubic foot (pcf) acting against the footings. The upper 1-foot of embedment should be neglected for resistance. The recommended values presented above are ultimate values, and should be used with an appropriate factor of safety.

4.2 2001 CALIFORNIA BUILDING CODE DESIGN PARAMETERS

The site is located in Seismic Zone 4 and can be classified, from a seismic standpoint, as being a relatively stiff site with soil depth exceeding 200 feet. The site is classified as Soil Profile Type S_D (average shear wave velocity for the upper 100 feet is estimated to be between 600 and 1,200 feet per second) as noted in Table 16-J of the 2001 California Building Code. The Monte Vista-Shannon fault, which passes about 2 miles to the south-southwest of the site, is considered a Type B seismic source and is considered the controlling fault for this site.

Based on the Seismic Source Type and closest distance to the known seismic source described above, the following values are recommended for use in design of the proposed Fire Station Number 17:

Seismic Zone Factor, Z = 0.4 (Table 16-I);
Near Source Factor, N_a = 1.18 (Table 16-S);
Near Source Factor, N_v = 1.44 (Table 16-T);
Seismic Coefficient, C_a = 0.44 N_a = 0.52 (Table 16-Q); and
Seismic Coefficient, C_v = 0.64 N_v = 0.92 (Table 16-R).

4.3 SLAB-ON-GRADE

We recommend the slab-on-grade floor of the new building be supported on a minimum section of 2 feet of engineered fill. Engineered fill constructed to support the new slab-on-grade floors should be compacted to a minimum relative compaction of 95 percent in accordance with ASTM Test Designation D1557 and meet the quality requirements for fill materials discussed in Section 4.5 and in the suggested guide specifications (Appendix C).

Moisture will come into contact with the floor slab due to moisture vapor migration and/or capillary water rise through the soil. If moisture in the floor slab is undesirable, some form of moisture barrier should be provided. It is recommended that a moisture barrier consisting of 4 inches of clean gravel or clean crushed stone be used as a capillary/moisture break. A moisture-proof membrane, such as 10-mil visqueen or equivalent, covered by 2 inches of moist sand should be placed above the rock. The sand should be moistened prior to placement of the concrete slab. The sand and gravel placed as part of the capillary break/moisture barrier system can be used as part of the recommended engineered fill section beneath the slab-on-grade floor.

4.4 PAVEMENTS

The near surface native and fill soils across the site consist primarily of lean clays with some gravels and are considered to exhibit moderate to high plasticity characteristics. The following recommended pavement sections are based on placing the pavement on the existing native soils with a design R-value of about 10.

Traffic Type	Recommended Pavement Section (inches)		
	Portland Cement Concrete	Asphalt Concrete	Class 2 Aggregate Base
Automobile Traffic and Parking Lot	-	3	7
Truck Access and Parking	-	4	10
Truck Access and Parking	8	-	6

All pavement sections should be constructed in accordance with Caltrans Standard Specifications, latest edition, except that the relative compaction should be based on ASTM Test Designation D 1557, using the dry density basis. In particular, the asphalt concrete pavements should conform to Caltrans Section 39, the concrete pavements should conform to Sections 40 and 90 and the Class 2 Aggregate Base should conform to Section 26 of Caltrans Standard Specifications. The top 6 inches of the pavement section subgrade should be compacted to at least 95 percent relative compaction. Additionally, all aggregate base should be compacted to at least 95 percent relative compaction. These pavement sections would be appropriate for a 20-year pavement design life.

The pavement subgrade underlying Class 2 Aggregate Base should be properly prepared and compacted to a minimum relative compaction of 95 percent in accordance with the recommendations outlined in Section 4.5.4, Subgrade Preparation. Subgrade moisture conditioning and compaction should be done just prior to placement of aggregate base. Deeper subgrade preparation than shown on the above table could be needed if localized soft or weak soil is encountered.

The aggregate base course should be compacted to a minimum relative compaction of 95 percent (ASTM Test Designation D1557). Aggregate base should conform to the requirements of Section 26 of the California Department of Transportation Standard Specifications for Class 2 Aggregate Base (1½ inch or ¾ inch maximum).

We recommend all pavement materials and construction conform to the applicable sections of the Caltrans Standard Specifications, as follows:

Pavement Material	Type of Material	Specification Section
Asphalt Concrete	Class B, ½-inch or ¾-inch maximum, dense graded	39
Aggregate Base	Class 2, 1-½ inch or ¾-inch maximum size	26
Asphalt Cement	AR-4000	92
Prime Coat	MC-70 or MC-250	93
Slurry Seal	As specified	37
Asphalt Emulsion	SS-1	37, 94

Additional recommendations for PCC pavement are as follows:

- Concrete should have a minimum modulus of rupture of at least 550 pounds per square inch (equivalent to a compressive strength of 3,700 psi) before the pavement is subjected to traffic.
- Provide expansion joints between buildings and pavements; the Contractor should provide a shop drawing indicating the proposed joint material.
- Provide weakened plane contraction joints at maximum 12-foot grid spacing by either saw cutting to a minimum depth of 3 inches or installing preformed material full depth; the purpose of these joints is to relieve tensile stresses, thereby minimizing the potential for volunteer cracking elsewhere in the pavement.
  - Saw cut width should be the minimum possible and less than ¼ inch.
  - Saw cut should occur within time period specified in Caltrans Specification Section 40-1.08B (1). Timing of the saw cutting is of the utmost importance, since it is necessary to saw the joint before volunteer cracking occurs. Typically, this is within 12 to 24 hours after concrete placement.
  - All joints should be sealed with joint filler in accordance with Caltrans Section 40-1.08B (1).
- Length of given panel should not exceed its width by more than 25 percent.
- Provide 6x6-W1.5xW1.5 welded wire mesh.
  - Place in middle of slab.
  - Do not place across joints.

A representative of URS should be retained during construction to review the soil conditions encountered and the construction procedures used.

4.5 EARTHWORK

All site preparation and earthwork should be done under the observation of a representative of our firm and in accordance with the recommendations presented below. Suggested guide specifications for "Earthwork" are presented in Appendix C.

4.5.1 Clearing and Stripping

Areas to be graded should be stripped and cleared of structures, foundations, trees, debris, and concrete flatwork. The Geotechnical Engineer should review the final depths of stripping and clearing during the site preparation. Materials resulting from clearing and stripping operations should be removed from the site. We recommend that stripped materials not be used as compacted fill or blended with other soils. Any existing foundations should be removed in their entirety.

After the site has been properly prepared, the Geotechnical Engineer should review the conditions before any fill is placed.

4.5.2 Demolition

The development of the site will require the removal of the existing residential structure, its foundations, swimming pool and underground utilities. In addition, any existing fills should be removed. This demolition work should be monitored by the Geotechnical Engineer.

Where underground utilities, trenches, etc., exist beneath the proposed building site and 10 feet beyond, abandonment should proceed in accordance with the following recommendations.

- All buried utilities and trenches located within an imaginary 1.5 horizontal to 1 vertical plane drawn downward from the lowest outside edge of the closest footing, and within a depth less than 5 feet below the bottom of the footing, should be removed.
- In proposed parking and driveway areas, all buried utilities and trenches located within 3 feet of the pavement subgrade (bottom of lowest pavement course) should be removed or filled with concrete.
- If not removed or filled with concrete, utilities left in place should be adequately plugged to inhibit entry of water.

All trench excavations should be backfilled in accordance with the recommendations presented for underground utilities (Section 4.6).

4.5.3 Excavations

Excavations should be performed to the lines and grades presented in the project plans and specifications. If unsuitable materials are encountered during excavations, these materials should be removed in its entirety and replaced with well compacted engineered fill. The Geotechnical Engineer should review the final excavation depths and lateral dimensions during construction.

4.5.4 Subgrade Preparation

After the excavation has been completed to the satisfaction of the Geotechnical Engineer, the exposed surface should be scarified to a minimum depth of 6 inches, moisture conditioned and recompacted. A minimum relative compaction of 95 percent should be attained in the subgrade.

4.5.5 Fill Materials

All general fill material should be a soil or soil-rock mixture that is free of organic matter and other deleterious substances. It should not contain rocks or lumps over 6 inches in the greatest dimension, and not more than 15 percent larger than 2-½ inches. The native soils are somewhat expansive and are not considered to be reusable as engineered fill.

We recommend that the fill consist of a low plasticity, non-expansive soil or soil-rock mixture having a plasticity index not greater than 15. A Geotechnical Engineer from our firm should approve any fill that is imported for use as engineered fill.

4.5.6 Fill Placement and Compaction

Fill material should be spread in uniform lifts not exceeding 8 inches in uncompacted thickness where heavy equipment is used, and not more than 4 inches where light, hand-operated compactors are used. Before compaction begins, the fill should be brought to a moisture content that will permit proper compaction by either aerating the material if it is too wet, or spraying the material with water if it is too dry. Each lift should be thoroughly mixed before compaction to provide a uniform distribution of water content. To prevent drying of the subgrade soils, placement of fill should start immediately after the surface preparation and should proceed in a continuous operation until the site is brought to grade.

All fill material beneath foundations and slab-on-grade floors should be compacted to a minimum relative compaction of 95 percent, and at moisture content between optimum and 2 percent above the optimum moisture content. Relative compaction is defined as the ratio of the insitu dry density to the maximum dry density obtained in the laboratory in accordance with ASTM D1557.

4.6 UNDERGROUND UTILITY TRENCHES

For purposes of this section of the report, bedding is defined as material placed in a trench up to 1 foot above a utility pipe and backfill is all material placed in the trench above the bedding.

Unless concrete bedding is required around utility pipes, free-draining sand should be used as bedding. Sand proposed for use in bedding should be tested in our laboratory to verify its suitability and to measure its compaction characteristics. Sand bedding should be compacted by mechanical means to achieve at least 95 percent relative compaction based on ASTM D1557.

Approved, on-site, inorganic soil, or imported material may be used as utility trench backfill. Proper compaction of trench backfill will be necessary under and adjacent to structural fill, building foundations, concrete slabs and vehicle pavements. In these areas, backfill should be conditioned with water (or allowed to dry) to produce a soil-

water content ranging between optimum and 2 percent above the laboratory optimum moisture content. All backfill should be placed in horizontal layers not exceeding 6 inches in thickness (before compaction). Each layer should be compacted to 90 percent relative compaction based on ASTM D1557. The upper 8 inches of pavement subgrade should be compacted to 95 percent relative compaction based on ASTM D1557.

Where any trench crosses the perimeter foundation line, the trench should be completely plugged and sealed with compacted lean clay soil for a horizontal distance of at least 2 feet on either side of the foundation.

The attention of Contractors, particularly the Underground Contractor, should be directed to the requirements of California Code of Regulations, Title 8, Construction Code Section 1540 regarding Safety Orders for "Excavations, Trenches, Earthwork."

4.7 SURFACE DRAINAGE

Surface drainage gradients should be planned to prevent ponding and to promote drainage of surface water away from building foundations, slabs, edges of pavements and sidewalks, and towards suitable collection and discharge facilities.

Water seepage or the spread of extensive root systems into the soil subgrades of foundations, slabs, or pavements, could cause differential movements and consequent distress in these structural elements. This potential risk should be given due consideration in the design and construction of landscaping.

This study provides geotechnical design parameters for the proposed Fire Station Number 17. The recommendations contained in this report are based on the information obtained from two exploratory borings completed at the site, and upon our experience and engineering judgment. We have assumed that the soil and geologic conditions at the site do not deviate substantially from those encountered or extrapolated from the exploratory borings.

If any variations or undesirable soil conditions are encountered during construction, or if the proposed construction will differ from that proposed at the present time, we should be notified so that supplementary recommendations can be provided, if necessary. URS should review the foundation and grading plans, and the specifications, prior to construction. All earthwork, grading and foundation construction also should be done under the observation of the Geotechnical Engineer.

No environmental studies were performed by URS for this project.

The recommendations presented in this report were developed with the standard of care commonly used in this profession. No other warranties are included, either express or implied, as to the professional advice included in this report.

Bortugno, E.J., McJunkin, R.D. and Wagner, D.L., 1991, Map showing recency of faulting, San Francisco-San Jose Quadrangle, California, California Division of Mines and Geology, Geologic Map of the San Francisco-San Jose Quadrangle, 1:250,000.

Bürgmann, R., Arrowsmith, R. and Dumitru, T., 1994, Rise and fall of the southern Santa Cruz Mountains, California, from fission tracks, geomorphology, and geodesy, Journal of Geophysical Research, v. 99B, p. 20,181-20,202.

California Division of Mines and Geology, 1974, Special Report 107, Potential Seismic Hazards in Santa Clara County, California

California Geological Survey, 2000, Digital images of official maps of the Alquist-Priolo earthquake fault zones of California, central coast region, Los Gatos Quadrangle: California Geologic Survey, CD-2000-004.

California Geological Survey, 2004, Seismic hazard zones, Los Gatos Quadrangle, gmw.consrv.ca.gov/shmp/index.htm

Cleary, J.M. and Hoexter, D.F., 2004, The Monte Vista fault, Foothill community college, Los Altos Hills, California, in AEG field trip guidebook, Seismic hazards of the range front thrust faults, northeastern Santa Cruz Mountains/Southwest Santa Clara Valley, p. S-1 to S-11.

Dibblee, T.W. and Brabb, E.E., 1978, Preliminary geologic map of the Los Gatos quadrangle, Santa Clara and Santa Cruz Counties, California, U.S. Geological Survey Open File Report 78-453, scale 1:24,000.

Fenton, C.H. and Hitchcock, C.S., 2002, Recent geomorphic and paleoseismic investigations of thrust faults in Santa Clara Valley, California, Engineering Geology Practice in Northern California, Ferriz, H. (ed.) California Division of Mines and Geology, p. 71-89.

Fisher, G.R., 2004, Coexistence of thrusting, extension and opportunistic landsliding on the Berrocal fault, Los Gatos, Santa Clara County, California, in Seismic hazards of the range front thrust faults, northeastern Santa Cruz mountains/southwest Santa Clara Valley, editors Kennedy, D.G. and Hitchcock, C.S., Association of Engineering Geologist Field trip Guidebook, March, 27.

Hitchcock, C.S. and Kelson, K.I., 1999, Growth of late Quaternary folds in southwest Santa Clara Valley, San Francisco Bay Area, California: Implications of triggered slip for seismic hazard and earthquake recurrence, Geology, v. 27, p. 387-390.

Jennings, C.W., 1994, Fault activity map of California and adjacent areas, California Division of Mines and Geology, California Geologic Data Map Series, Map No. 6, 1:750,000 scale.

Jones, D.L., Graymer, R., Wang, C., McEvilly, T.V. and Lomax, A., 1994, Neogene transpressive evolution of the California Coast Ranges, Tectonics, v. 13, p. 561-574.

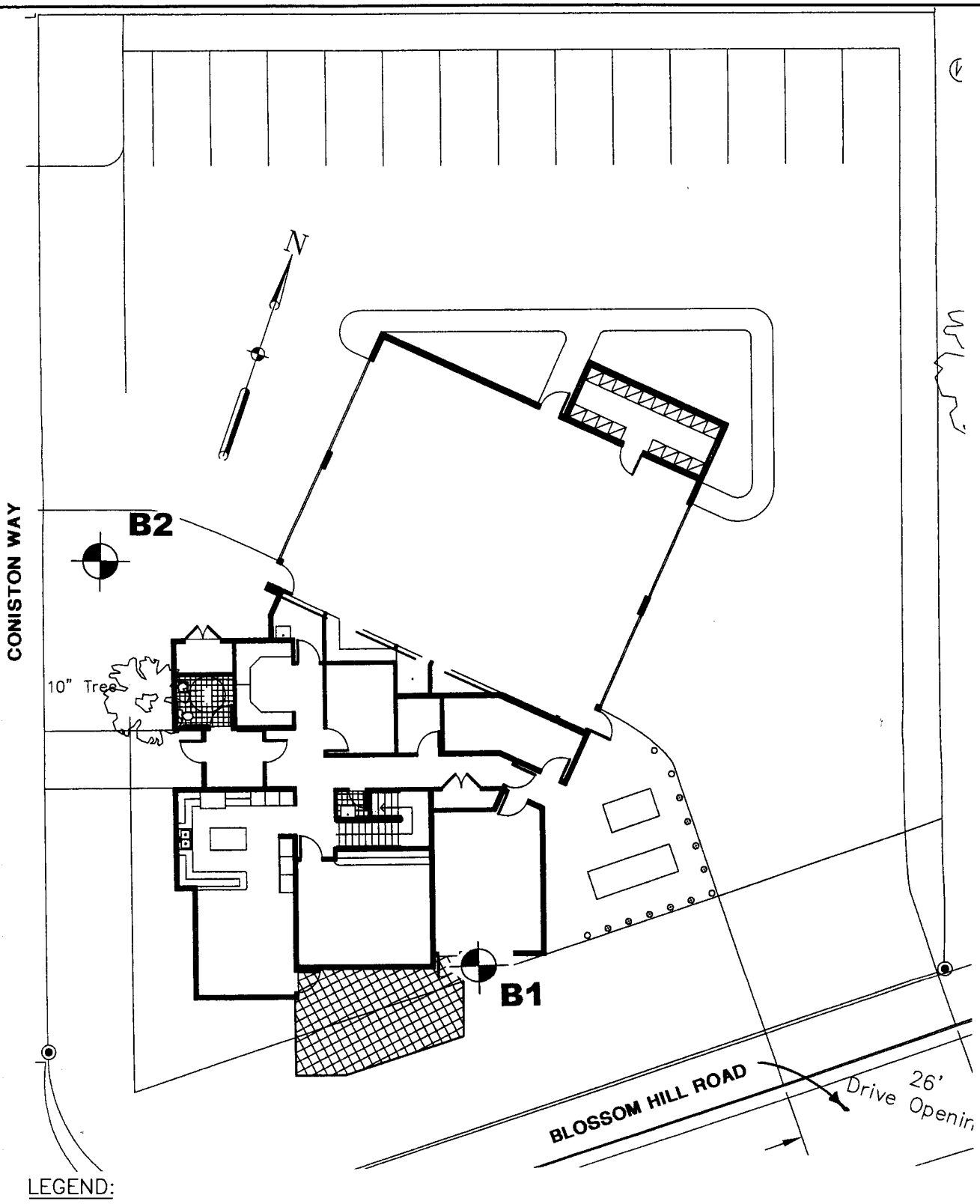
Knudsen, K.L., Sowers, J.M., Witter, R.C., Wentworth, C.M. and Helley, E.J., 2000, Preliminary maps of Quaternary deposits and liquefaction susceptibility, nine-county San Francisco Bay region: A digital database, U.S. Geological Survey, Open-File Report 00-444, 60 p.

Santa Clara County Geologic Hazard Zones, 2002, map sheet 36, www.sccplanning.org

Santa Clara Valley Water District Flood Hazard maps, www.scvwd.dst.ca.us

BASE MAP FROM C.S.A.A.

URS	Project No. 28649627 **Fire Station Number 17** San Jose, California	**SITE LOCATION PLAN**	**Figure 1**



URS	Project No. 28649627 **Fire Station Number 17** San Jose, California	**SITE AND BORING LOCATION PLAN**	**Figure 2**

FIELD EXPLORATION PROGRAM

A field investigation performed on February 1, 2005 consisted of drilling and logging two borings to depths of 25½ and 50½-feet. The borings were drilled with a 4-7/8 inch rotary rig owned and operated by Pitcher Drilling. The approximate locations of the borings are shown on Figure 2. Both drive samples taken with a modified California hand-operated sampler (2-inch ID and 2.5-inch 0D) and grab samples placed in plastic bags were obtained from the borings. In situ tests using a pocket penetrometer in the cohesive soils were also performed. Figure A-2 presents a Log of Boring Legend of the borings along with sample locations and in situ test results are presented in this Appendix.

Preliminary soil classifications were made in the field in accordance with the Unified Soil Classification System, as shown on Figure A-1, and were verified by further examination of the samples in the laboratory and by testing. Figure A-2 presents a Log of Boring Legend. Logs of the borings were prepared based on the field and laboratory test data and are presented in Figures A-3 and A-4.

LABORATORY TESTING

Relatively undisturbed soil samples were carefully packaged in the field and sealed to prevent moisture loss. The samples were then transported to our San Jose laboratory for examination and testing. Laboratory tests were performed on selected samples as an aid in classifying the soils and to evaluate the physical properties of the soils. Detailed descriptions of the laboratory tests are presented below under the appropriate test headings. Test results are presented in the figures that follow.

Moisture Content and Dry Density

Moisture content and dry density determinations were made on selected samples. The samples were first trimmed to obtain volume and wet weight, and then were dried in accordance with ASTM D2216 and D2937. After drying, the weight of each sample was measured, and moisture content and dry density were calculated. The results of the individual tests are presented in the Log of Boring sheets.

Unconfined Compressive Strength

The unconfined compressive strength was estimated for selected samples. These tests were performed in accordance with ASTM D2166. The axial load applied was measured with a load cell at an axial strain rate of 1.0 percent per minute. Loading was continued until the axial load reached a peak value. The results of these tests are shown in the Log of Boring sheets.

Grain Size Distribution

Grain size analyses were performed on selected samples to evaluate the proportion of gravel, sand, and fine materials. A representative soil sample was dried, weighed, and

tested in general accordance with ASTM D422. The test results are presented in Figure A-5.

Plasticity Index

Plasticity characteristics of the native soil and fill soil were determined for two selected samples by performing Liquid Limit and Plastic Limit tests generally in accordance with ASTM test method D4318. The results of these tests are presented on Figure A-6.

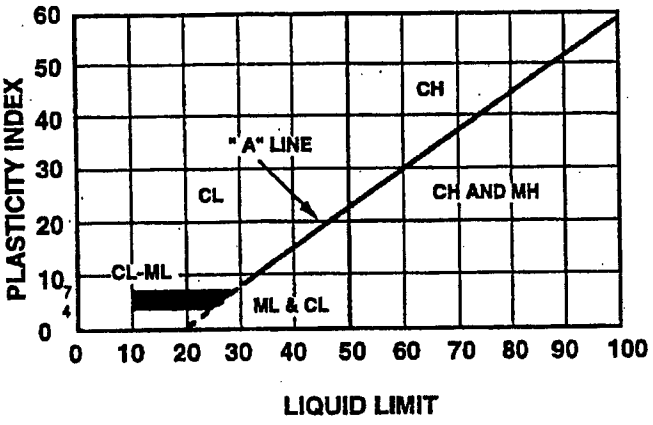
R-Value

An R-Value test was performed on a sample representative of the near surface soils. The test was performed in accordance with the Caltrans Test Designation 301. The test results are shown on Figure A-7.

SAMPLE CLASSIFICATION CHART

UNIFIED SOIL CLASSIFICATION SCHEME			
MAJOR DIVISIONS		**SYMBOLS**	**TYPICAL NAMES**
COARSE GRAINED SOIL (More than 1/2 of soil >no. 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > no. 4 sieve size)	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
		GP	Poorly graded gravel or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SAND (More than 1/2 of coarse fraction < no. 4 sieve size)	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOIL (More than 1/2 of soil <no. 200 sieve size)	SILTS & CLAYS Liquid Limit < 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey, fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

PLASTICITY CHART



GRAIN SIZE CLASSIFICATION		
CLASSIFICATION	**RANGE OF GRAIN SIZES**	
	U.S. Standard Sieve Size	**Grain Size in Millimeters**
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.76
coarse (c)	3" to 3/4"	76.2 to 19.1
fine (f)	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.074
coarse (c)	No. 4 to No. 10	4.76 to 2.00
medium (m)	No. 10 to No. 40	2.00 to 0.420
fine (f)	No. 40 to No. 200	0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

MOISTURE CONTENT	
DRY	-No sign of water and soil dry to touch
MOIST	-Signs of water and soil is relatively dry to touch
WET	-Signs of water and soil definitely wet to touch; granular soil exhibits some free water when densified

SOIL CONSISTENCY/RELATIVE DENSITY				
SILT, SAND AND GRAVEL	**BLOWS/FT**	**SILT OR CLAY**	**UNCONFINED COMPRESSIVE STRENGTH (psf)**	**THUMB PENETRATION**
Very loose	<4	Very Soft	< 500	Very easily - inches
Loose	5-10	Soft	500 - 1000	Easily - inches
Medium Dense	11-30	Medium (firm)	1000 - 2000	Moderate effort - inches
Dense	31-50	Stiff	2000 - 4000	Indented easily
Very Dense	>50	Very Stiff	4000 - 8000	Indented by nail
		Hard	> 8000	Difficult by nail

CLASSIFICATION MODIFIERS	
TRACE	0 - 12%
SOME	12 - 30%
± MODIFIERS	

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Figure A-1

FIRE STATION #17; San Jose, California

BORING LOCATION:			GROUND SURFACE ELEVATION (ft): TOP OF WELL CASING ELEVATION (ft):
DRILLING AGENCY	DRILLER		DATE STARTED: DATE FINISHED:
DRILLING EQUIPMENT			COMPLETION DEPTHS: BORING: 45.0 (ft) WELL: (ft)
DRILLING METHOD (as noted)	DRILL BIT		HAMMER/ DROP (as noted)
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES: DIST: UNDIST:
TYPE OF PERFORATION	FROM TO		WATER DEPTH (ft): FIRST: 28 ▽ COMPL.: 32 ▼ 24 hr.: ▽
SIZE AND TYPE OF PACK	FROM TO		LOGGED BY / CHECKED BY

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1:			No. 3:		
	No. 2:			No. 4:		

LOG OF LEGEND

(Sheet 1 of 1)

DEPTH (feet)	SOIL GRAPHIC	MATERIAL DESCRIPTION	ELEVATION (feet)	FIELD TESTS: POCKET PEN (tsf)	FIELD TESTS: POCKET TV (psf)	FIELD TESTS: STRAIN AT FAILURE, %	FIELD TESTS: WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY (%)	SAMPLES: BLOWS /foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	INDEX PROPERTIES: DRY DENSITY (pcf)	INDEX PROPERTIES: UNCONFINED COMPRESSIVE STRENGTH (psf)	NOTES
		Arrow denotes bottom of fill layer FILL														
5		← 2 inch inside diameter Modified California sample						5								
10		← 2 inch outside diameter Standard Split Spoon sample (Standard Penetration Test)						10								
		← 3 inch outside diameter Shelby tube sample														
15		← Hydraulic Pressure required to push Shelby tube sampler						15				350 psi				
20		← Blow count with 140-lb hammer falling 30 inches for 12 inches of penetration						20				29				
25		← Blow count with 140-lb hammer falling 30 inches for 5 inches of penetration						25				50/ 5"				
		Groundwater level at time of drilling					▽									
30							▼	30								
		Groundwater at a time after drilling (as specified)														
35		**KEY TO LABORATORY TESTS** PP = Pocket Penetrometer reading in tons per square foot (tsf) LL = Liquid Limit (%) PI = Plasticity Index (%) NOTE: PI = LL - (Plastic Limit [%]) +#4 = Percentage of material retained on #4 sieve -#200 = Percentage of material passing #200 sieve		3.0				35								PP = 3.0tsf LL = 42 PI = 21 +#4 = 13% -#200 = 10%
40								40								

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PROJECT NO. 28649627

Fig: A-2

FIRE STATION #17; San Jose, California

BORING LOCATION: Blossom Hill & Coniston - South			GROUND SURFACE ELEVATION (ft): TOP OF WELL CASING ELEVATION (ft):
DRILLING AGENCY		DRILLER	DATE STARTED: 2/1/05 DATE FINISHED: 2/1/05
DRILLING EQUIPMENT			COMPLETION DEPTHS BORING: 50.5 (ft) WELL: N/A (ft)
DRILLING METHOD	Rotary Wash	DRILL BIT	HAMMER/ DROP 140lb/30in
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES DIST: UNDIST:
TYPE OF PERFORATION	N/A	FROM N/A TO N/A	WATER DEPTH (ft) FIRST: N/A COMPL.: N/A 24 hr.: N/A
SIZE AND TYPE OF PACK	N/A	FROM N/A TO N/A	LOGGED BY S.Ball / CHECKED BY J.Landazuri

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	50.5'	No. 3: N/A	N/A	N/A
	No. 2: N/A	N/A	N/A	No. 4: N/A	N/A	N/A

LOG OF BORING B1

(Sheet 1 of 2)

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	FIELD TESTS: POCKET PEN (tsf)	POCKET TV (psf)	STRAIN AT FAILURE, %	WATER LEVEL	SAMPLES: DEPTH (feet)	NUMBER	TYPE	RECOVERY (%)	BLOWS /foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	NOTES
	Sandy lean CLAY (CL) Stiff, moist, brown, trace gravel and organics		1.0		10.0			1		55	14	20	107	2500	LL = 32 PI = 13
	Very moist at 3.5 feet due (possibly to rain or irrigation drainage), hard														
5	Hard		4.5		10.0		5	2		80	32	19	112	8640	
10	Very stiff		3.5		8.1		10	3		90	39	17	116	4120	
15	**Clayey GRAVEL (GC/SC) with sand** Medium dense, moist, brown, gravel to 1-1/2 inch						15	4		90	30	10			+#4 = 36% -#200 = 13% Began rotary wash
20	**Sandy lean CLAY (CL) with gravel** Stiff, moist, brown		1.5				20	5		45	22				
25	**Clayey GRAVEL (GC) with sand** Very dense, moist, brown						25	6		55	87				
	Sandy lean CLAY (CL) with gravel Soft, very moist, red brown, gravel to 1 inch		<0.5					7		40	28				
30	**Poorly graded GRAVEL (GP-GC) with clay and sand** Very dense, moist, light reddish-brown						30	8		75	63				

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PROJECT NO. 28649627

Fig: A-3

FIRE STATION #17
San Jose, California

LOG OF BORING B1
Continued- Sheet 2 of 2

DEPTH (feet)	SOIL GRAPHIC	MATERIAL DESCRIPTION	ELEVATION (feet)	FIELD TESTS: POCKET PEN (tsf)	FIELD TESTS: POCKET TV (psf)	FIELD TESTS: STRAIN AT FAILURE, %	FIELD TESTS: WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY (%)	SAMPLES: BLOWS /foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	INDEX PROPERTIES: DRY DENSITY (pcf)	INDEX PROPERTIES: UNCONFINED COMPRESSIVE STRENGTH (psf)	NOTES
35		**Sandy lean CLAY (CL)** Stiff, moist, red-brown, trace sand		2.5		10.0		35	9		75	30	22	108	3940	
40		With sand and gravel lenses		1.5				40	10		95	52				
45		**Well-graded GRAVEL (GW) with sand** Very dense, brown, trace clay						45	11			50/3"				
50		BOTTOM OF BORING AT 50-1/2 FEET						50	12			58				
55								55								
60								60								
65								65								
70								70								

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PROJECT NO. 28649627

Fig: A-3

FIRE STATION #17; San Jose, California

BORING LOCATION: Blossom Hill & Coniston - West			GROUND SURFACE ELEVATION (ft): TOP OF WELL CASING ELEVATION (ft):
DRILLING AGENCY		DRILLER	DATE STARTED: 2/1/05 DATE FINISHED: 2/1/05
DRILLING EQUIPMENT			COMPLETION DEPTHS: BORING: 25.5 (ft) WELL: N/A (ft)
DRILLING METHOD: Rotary Wash		DRILL BIT	HAMMER/ DROP: 140lb/30in
SIZE AND TYPE OF CASING			NUMBER OF SAMPLES: DIST: UNDIST:
TYPE OF PERFORATION: N/A		FROM N/A TO N/A	WATER DEPTH (ft): FIRST: N/A ▽ COMPL.: N/A ▽ 24 hr.: N/A ▽
SIZE AND TYPE OF PACK: N/A		FROM N/A TO N/A	LOGGED BY: S.Ball; CHECKED BY: J.Landazuri

TYPE OF SEAL	TYPE	FR	TO	TYPE	FR	TO
	No. 1: Cement	0	25.5'	No. 3: N/A	N/A	N/A
	No. 2: N/A	N/A	N/A	No. 4: N/A	N/A	N/A

LOG OF BORING B2

(Sheet 1 of 1)

DEPTH (feet)	SOIL GRAPHIC	MATERIAL DESCRIPTION	ELEVATION (feet)	FIELD TESTS: POCKET PEN (tsf)	POCKET TV (psf)	STRAIN AT FAILURE, %	WATER LEVEL	DEPTH (feet)	SAMPLES: NUMBER	TYPE	RECOVERY (%)	BLOWS /foot	INDEX PROPERTIES: MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	NOTES
		Lean CLAY (CL) Stiff, moist, brown, trace sand and gravel		2.0					1		50	14				Began rotary wash
5		Hard		>4.5		10.0		5	2		65	26	18	115	9270	LL = 40 PI = 20
10		**Well-graded GRAVEL (GW) with sand** Medium dense to dense, brown, trace clay						10	3		55	47				
15		**Poorly graded GRAVEL (GP-GC) with clay and sand** Dense, moist, brown						15	4		45	38	12			+#4 = 66% -#200 = 6%
20		**Sandy lean CLAY (CL) with gravel** Stiff, wet, brown **Poorly graded SAND (SP) with gravel** Dense, wet, red brown						20	5		75	43	13	125		
		Poorly graded GRAVEL (GP) with sand Dense to very dense, wet, light brown, gravel to 1 inch, trace clay							6		15	55				
25		BOTTOM OF BORING AT 25-1/2 FEET						25	7		60	50/6"				
30								30								

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PROJECT NO. 28649627

Fig: A-4

2/28/05 JSIEVE 9627E

Project : FIRE STATION #17

Project No. 28649627

GRAIN SIZE DISTRIBUTION CURVES

Fig. A-5

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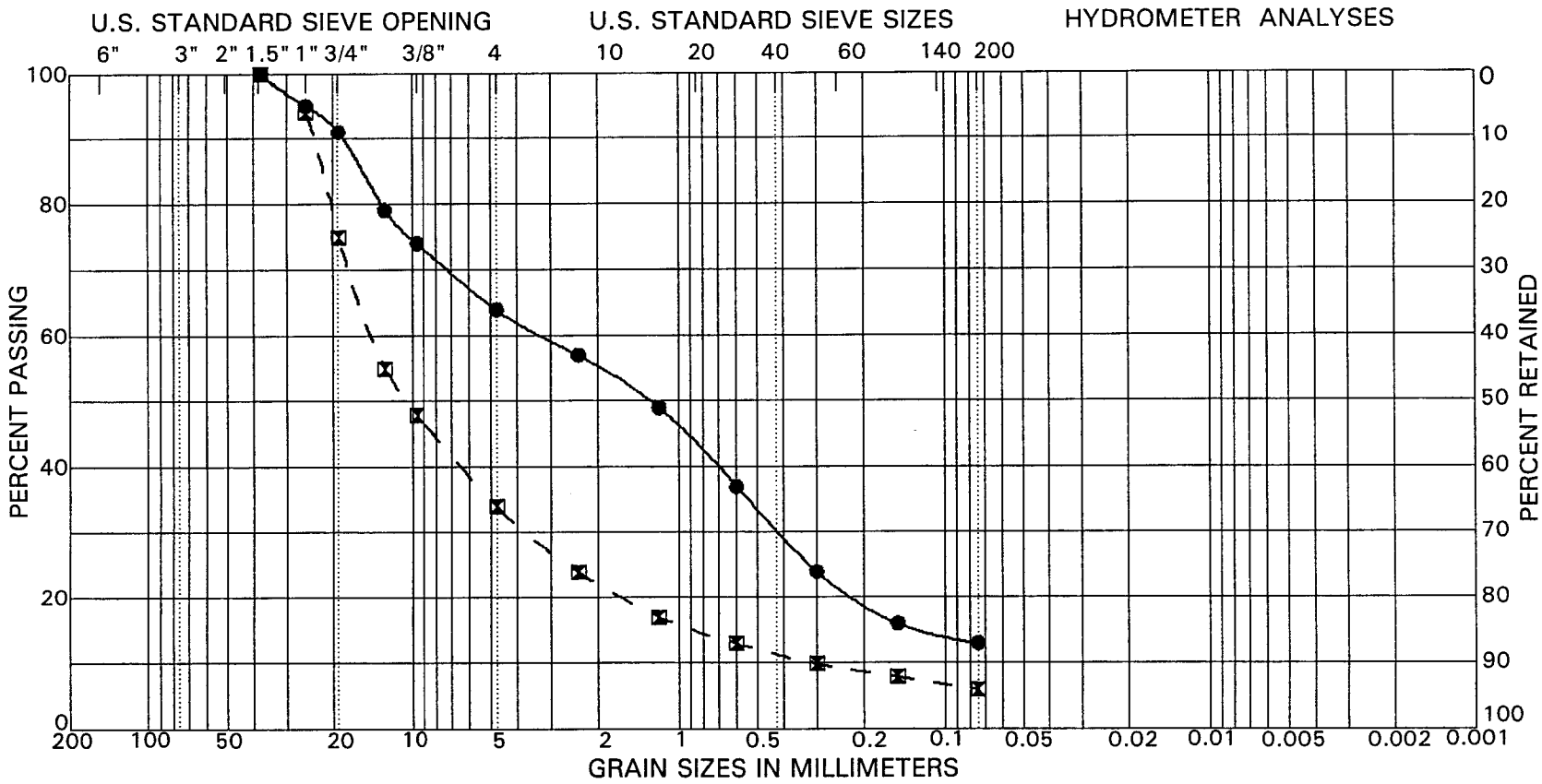
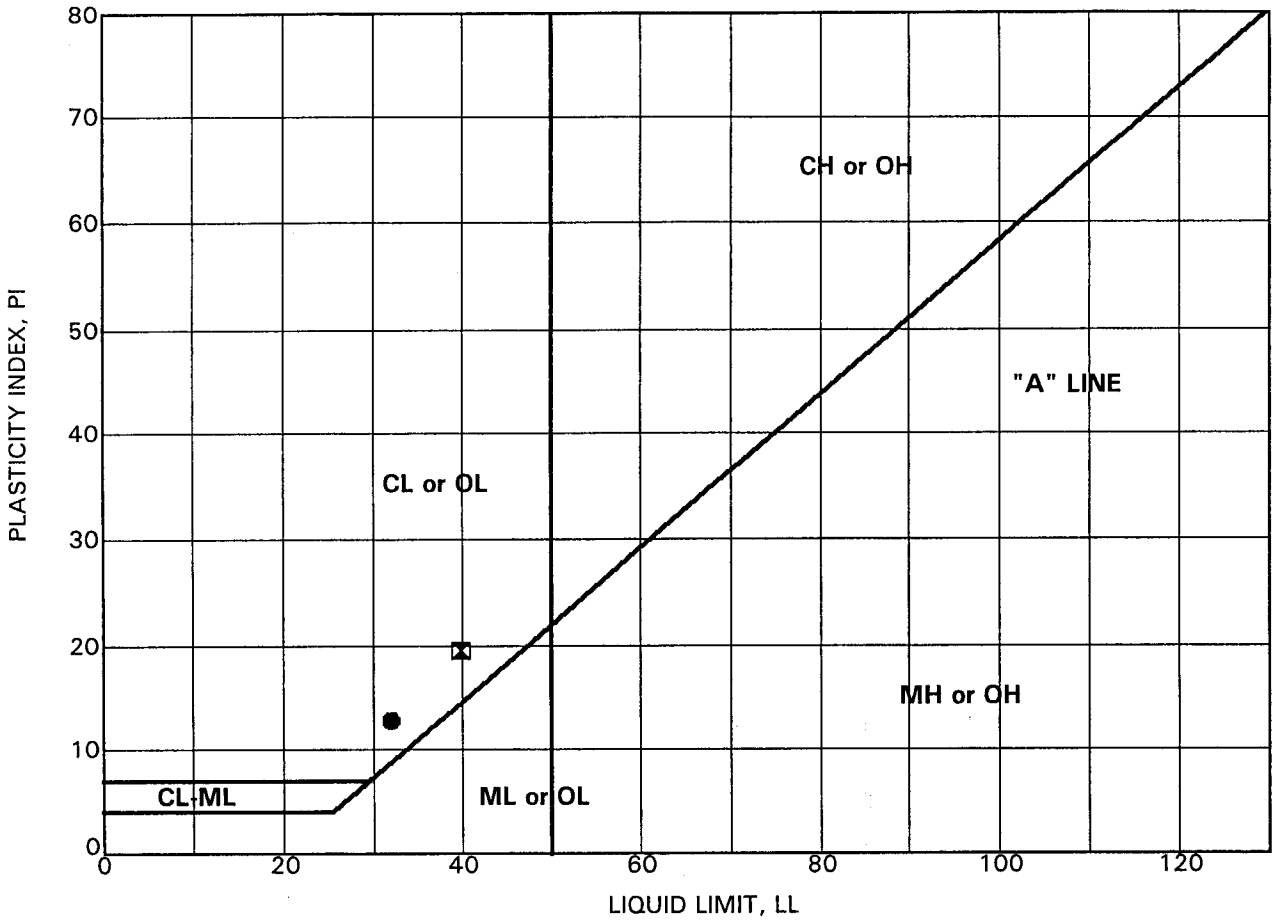
UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	coarse	fine	coarse	medium	fine	



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Classification
B1	4	15	●			Clayey SAND (SC) with gravel
B2	4	15	⊠			Poorly graded GRAVEL (GP-GC) with clay and sand



Boring Number	Sample Number	Depth (feet)	Test Symbol	Moisture Content (%)	LL	PL	PI	Description
B1	1	2	●	20	32	19	13	Lean CLAY (CL) with sand
B2	2	5	⊠	18	40	20	20	Sandy lean CLAY (CL)

Project: FIRE STATION #17
Project Number: 28649627

PLASTICITY CHART

Figure A-6

2/28/05 JATT94 9627E

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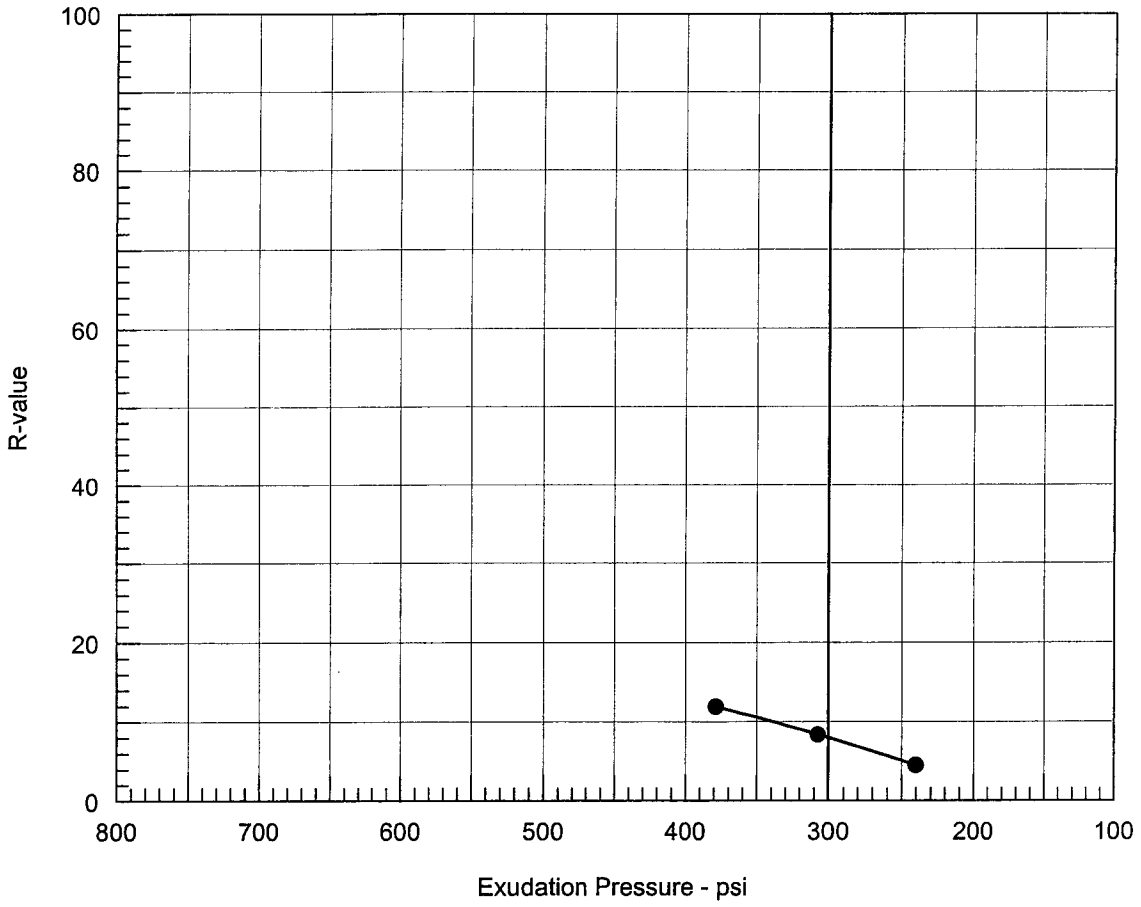
R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	75	114.7	15.7	0.00	140	2.70	307	8	8
2	95	112.9	16.6	0.00	148	2.69	240	4	5
3	100	116.3	14.8	0.12	133	2.59	379	11	12

Test Results	Material Description
R-value at 300 psi exudation pressure = 8	Brown silty clay with gravel

Project No.: 28649628
Project: Fire Station No. 17
Source of Sample: 2-10-05
Sample Number: 1
Date: 2/24/2005

Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

FIGURE A–7

LIQUEFACTION ANALYSIS - Fire Station #17

Project	Fire Station #17	
Proj. #	28649627.00000	
Boring	B-2	
PGA =	0.497	
M_w =	7.9	
GW exist.	15	ft
GWT during EQ	15	ft
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7
$CSR_M/CSR_{M=7.5}$	0.86	

Hammer type :	Type	C_E	Code	C_E
	Donut	0.75	1	2
	Safety	0.95	2	
	Auto	1.05	3	

Borehole Diameter	(inch)	(mm)	C_B	C_B
	2.5-4.5	65-115	1	1
	6	150	1.05	2
	8	200	1.15	3

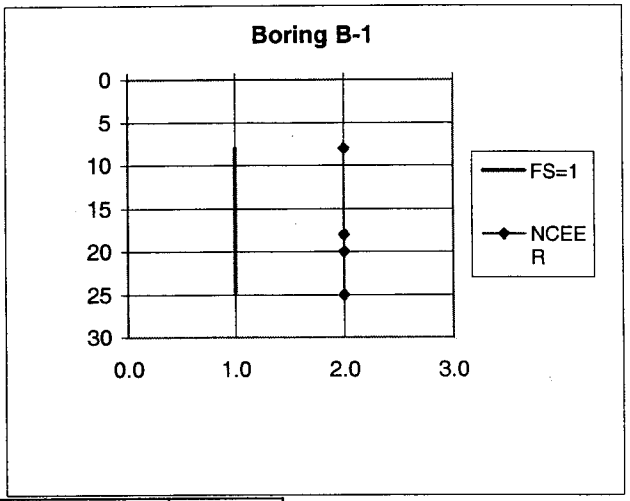
Rod Length	(feet)	(m)	C_R	C_R
	Default		999	

Sampling Method	Type	Cs	Code	Cs
	Stand	1	1	1
	No liners	1.2	2	

				At Center of Layer													
	Depth to	Depth to			In situ		EQ			EQ						Corrections of	
Soil	Layer Bottom	Layer Bottom	γ_m	σ_o	u	σ'_o	u	σ'_o							Fines Conter	$N_{60\text{-}cs}$	C_N
USCS	ft	m	pcf	psf	psf	psf	psf	psf	rd	CSR	N raw	Sampler	N SPT		%	fc< 5%	In-Situ
CL	8.0	2.44	131	524.0	0	524	0	524	0.983	0.318	14	M	11.2		100	18.4	1.70
GC	18.0	5.49	135	1723.0	0	1723	0	1723	0.962	0.311	47	S	47		6	47.3	1.11
CL	20.0	6.10	130	2528.0	250	2278	250	2278	0.957	0.343	43	M	34.4		100	46.3	0.96
GC	25.0	7.62	135	2937.5	468	2470	468	2470	0.942	0.362	55	S	55		6	55.3	0.93

Depth to	Thickness	σ_o	u	σ'_o	rd	$(N_1)_{60\text{-}cs}$	Liquefy	τ_{cyc}	$CSR_{M=7.5}$	CSR_M		Vol. Strain		Sett
Layer Bottom	ft	psf	psf	psf			NCEER	psf	τ_{cyc}/σ'_o	τ_{cyc}/σ'_o		%		in
8.0	8.0	524	0	524	0.983	26.3	N	166.5	0.32	0.37		0		0.0
18.0	10.0	1723	0	1723	0.962	42.3	N	535.4	0.31	0.36		0		0.0
20.0	2.0	2528	250	2278	0.957	40.3	N	781.5	0.34	0.40		0		0.0
25.0	5.0	2938	468	2470	0.942	46.2	N	893.8	0.36	0.42		0		0.0

Total Settlement=	0.0	inches



								Magnitude Corrections			Overburden	Slope	Note: F.S. greater than 2 is set to be equal to 2			
f SPT-N Value for Borings								NCEER								
C_N	C_E	C_B	C_R	C_S	$(N_1)_{60\text{-}cs}$	$(N_1)_{60\text{-}cs}$	$CRR_{7.5,1atm}$	K_m			K_σ	K_α	Above GW	F.S.	Liquefy ?	F.S=1.0
EQ					In-Situ	during EQ	Critical	Lower	Upper	Middle		(horizontal)		NCEER	NCEER	
2.00	0.95	1.00	0.75	1.00	22	26	0.305	0.88	0.84		1.000	1.00	Y	2.00	N	1
1.11	0.95	1.00	0.85	1.00	42	42	1.050	0.88	0.84		1.000	1.00	Y	2.00	N	1
0.96	0.95	1.00	0.95	1.00	40	40	1.050	0.88	0.84		0.988	1.00	Y	2.00	N	1
0.93	0.95	1.00	0.95	1.00	46	46	1.050	0.88	0.84		0.976	1.00	Y	2.00	N	1

The following Guide Specifications for Earthwork, Section 02200, incorporates geotechnical input in general conformance with CSI format. The Architect, Structural and Civil Engineers should thoroughly review the section to confirm its applicability to the Fire Station Number 17 and make any necessary revisions.

6.1.1 Section 02200

6.1.2 EARTHWORK

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General Conditions and Division 1 - Specification sections, apply to work of this section

1.1 SUMMARY:

Section Includes:

Earthwork as shown on the drawings for the following:

General Site grading, cut, fill and finish.
Excavation and backfill for structure construction.
Preparation of subgrade for concrete flatwork, ramps and pavements.
Distribution of stockpiled topsoil.
Structural fills for foundation support.
Utility line trenching and backfilling within building lines.

Related Sections:

Subsurface Information: Section 02010
Site Clearing: Section 02230.
Trenching: Section 02321.
Foundation Drainage Piping: Section 02635.
Sewerage and Drainage Piping: Section 02513.
Asphalt Concrete Paving: Section 2745
Portland Cement Concrete Paving: Section 02753
Concrete, Controlled Density Fill and Compaction Grouting: Division 3 sections.
Excavation and Backfilling for Mechanical and Electrical Work: Divisions 15 and 16 sections.

1.2 DEFINITIONS:

Excavation: Consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

Unauthorized Excavation: Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be at Contractor's expense.

Subgrade: Undisturbed earth or the compacted soil layer immediately below granular subbase, drainage fill, or topsoil materials.

Structure: Buildings, foundations, slabs, tanks, curbs, or other manmade stationary features occurring above or below ground surface.

1.3 SUBMITTALS

Test Reports-Excavating, Filling and Grading

The Owner's Geotechnical Engineer will perform the following tests, with a copy to the Contractor:

- Field density reports for fills and backfills.
- Testing reports on borrow material, including mechanical analysis, moisture-density curve and plasticity index.
- Verification of each footing subgrade.
- One optimum moisture-maximum density curve for each type of soil encountered.

1.4 QUALITY ASSURANCE:

Codes and Standards:

Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

Geotechnical Services:

The Geotechnical Engineer will be the Owner's representative to observe the grading operations both during preparation of the site and the compaction of engineered fill. He will make visits to the site to familiarize himself generally with the progress and quality of the work. He will make field observations and tests to enable him to form an opinion regarding the adequacy of the site preparation, the acceptability of fill materials and the extent to which the earthwork construction and the relative compaction comply with the specification requirements.

1.5 PROJECT/SITE CONDITIONS:

Site Information:

Soil Investigation and test reports are available for examination as set forth in Section 02010.

Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.

Existing Utilities:

Locate existing underground utilities in the areas of work as specified in Section 01105. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with Owner and utility companies in keeping utilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

Use of Explosives:

The use of explosives is not permitted.

Protection of Persons and Property:

Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

Cleaning:

Excavator is required to maintain adjacent streets free of dirt accumulation arising out of work of this section. Use suitable means of cleaning equipment, streets or both and to meet requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS:

Soil materials, whether from sources on or off site must be approved by the Geotechnical Engineer as suitable for intended use and specifically for required location or purpose.

General Fill:

General fill material shall be a soils or soil-rock mixture, which is free of organic matter or other deleterious substances. The fill material shall not contain rocks or lumps over 6″ in maximum dimension and not more than 15% larger than 2-1/2″. Materials from the site, if free of organic matter, rubble or other deleterious substances, are suitable for use in general fills.

Select Material:

In addition to the above requirements for general fill, select material shall be a low plasticity, non-expansive soil or soil-rock mixture having a plasticity index not greater than 15.

Imported Material:

All imported material shall be of select quality. The Contractor shall give at least 4 days notice prior to bringing imported material to the site to enable the Geotechnical Engineer to sample and test the material.

Aggregate Base:

Aggregate base for use beneath pavements, steps and walks shall conform to the requirements of Class 2 aggregate base, 3/4" maximum size as defined in Section 26 of the Caltrans Standard Specifications.

Drainage Fill:

Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, reasonably uniform size, with maximum size of 1-1/2" and not more than 3% passing a No. 200 sieve, as acceptable to the Geotechnical Engineer.

Unclassified Backfill:

Satisfactory off-site soil materials or on-site materials acceptable to Geotechnical Engineer, free of rock or gravel larger than 2" in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

Filter Fabric:

Type 140N by TC Mirafi, or approved equal.

PART 3 - EXECUTION

3.1 EXCAVATION:

Excavation Classifications:

All excavation is to be considered as "unclassified".

Unauthorized Excavation:

Backfill and compact unauthorized excavations as specified for authorized excavation of same classification, unless otherwise directed by Architect.

Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom, without altering required top elevation. Controlled density fill or lean concrete fill may be used to bring elevations to proper grades, when acceptable to the Geotechnical Engineer.

Additional Excavation:

When excavation has reached required subgrade elevations, notify the Geotechnical Engineer who will make an observation of conditions.

If unsuitable bearing materials are encountered at the required subgrade elevations, carry excavations deeper and replace the excavated material as directed by the Geotechnical Engineer.

Removal of unsuitable material and its replacement as directed will be paid on the basis of contract conditions relative to changes in the work.

Stability of Excavations:

Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

Dewatering:

Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.

Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, and soil changes detrimental to stability of subgrades and foundations.

Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Provide dewatering system if ground water is less than two feet below bottom of spread footing.

Convey water removed from excavations and rain water to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure.

Do not use foundation trench excavations as temporary drainage ditches.

Cold Weather Protection:

Protect excavation bottoms against freezing when atmospheric temperature is less than $35^{O}F$.

Excavated Material Storage:

Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.

Locate and retain soil materials away from edge of excavations.

3.2 EXCAVATION FOR STRUCTURES:

Conform to elevations and dimensions shown within a tolerance of ±0.10'; the final lateral extent of excavation for engineered fill construction, and controlled density fill or lean concrete placement shall be approved by the Geotechnical Engineer.

Foundations:

In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete.

Replacement Zone:

Remove existing man-made fill materials from all areas of the building to a point at least 5' beyond the building line.

Fill material may be cleaned to remove trash, debris, organic materials and rocks over 3" in any dimension and used for backfill or disposed of off-site at Contractor's option.

Grade bottom of excavation at replacement zone to drain to the foundation and subsurface drainage system.

Underground Tanks, Basins and Mechanical or Electrical Structures:

Conform to elevations and dimensions indicated within a tolerance of ±0.10' plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection. Do not disturb bottom of excavations, intended for bearing surface.

Excavation for Pavements:

Cut surface under pavements to comply with cross-sections, elevations and grades as shown.

Leave subgrades at elevations required for subgrade preparation, paving and base courses shown on drawings.

3.3 EXCAVATION FOR TRENCHES: (Utilities Within Building Lines)

Excavate trenches to uniform width, sufficiently wide to provide ample working room but not less than 9" on either side of pipe or conduit.

Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations. Beyond the building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

For pipes or conduit less then 6" in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.

For pipes and equipment 6" or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90^{O} (bottom 1/4 of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads and ensure continuous bearing of pipe barrel on bearing surface.

3.4 BACKFILL AND FILL:

Ground Surface Preparation:

Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface and scarify prior to placement of fills. Plow, strip, or break-up to 6" depth sloped surfaces to receive more than 6 feet of fill if steeper than 1 vertical to 5 horizontal so that fill material will bond with existing surface and step or bench the slope as required.

When existing ground surface has a relative compaction less than that specified under "Compaction" for the particular area classification, scarify, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

Placement and Backfill:

Place acceptable soil material in layers to required subgrade elevations for each classification listed below, using specified materials.

In over-excavation and replacement zone beneath foundations, use satisfactory select quality onsite material or imported borrow.

In areas not subject to structural loads, provide unclassified backfill around structures beyond 5' from foundation wall and for embankments and landscape areas with top 6" being topsoil stockpiled on site.

For foundation wall backfill, use select quality on-site fill within 5' from wall.

Under walks, steps and pavements, use aggregate base material, for upper 4" to 8" and select quality backfill or imported borrow material where additional fill is required.

Backfill trenches with concrete where trench excavations pass within 18" of column or wall pile cap and which are carried below bottom of such pile cap. Place concrete to level of bottom of adjacent pile cap.

Do not backfill trenches until tests and inspections have been made and backfilling authorized by Architect. Use care in backfilling to avoid damage or displacement of pipe systems.

Provide a 4" thick concrete base slab support for piping or conduit less than 2' -6" below surface of roadways. After installation and testing of piping or conduit, provide minimum 4" thick encasement (sides and top) on concrete prior to backfilling or placement of roadway subbase.

Backfill excavations as promptly as work permits, but not until completion of the following:

Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, perimeter insulation, and basement and first floor slabs unless foundations are braced to prevent damage and movement.

Inspection, testing, approval, and recording locations of underground utilities.

Removal of concrete forms, temporary shoring, trash and debris.

Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage or maximum dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.

3.5 COMPACTION

Control soils and fill compaction during construction, providing minimum percentage of density specified for each area classification. Correct improperly compacted areas or lifts as directed by the Architect if soil density tests indicate inadequate compaction.

Relative Compaction Requirements:

Compact soil to not less than the following percentage of maximum dry density determined in accordance with ASTM D1557.

Engineered Fills: Compact top 6" of subgrade and each layer of backfill or fill material to 95% of maximum dry density.

Retaining Wall Backfill: Compact each layer of backfill material to 90% of maximum dry density.

Exterior Slabs, Steps, Walkways, Pavements: Compact top 6" of subgrade and each layer of backfill and aggregate base material to 95% of maximum dry density.

Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material at 90% or relative density.

Moisture Control: Where subgrade or layer or soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer or soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Remove and replace, or scarify and air dry soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

Maintain moisture content of fill or backfill material to within optimum as determined by ASTM D1557, as follows.

Over-Excavation Replacement Zone: ..... 0 to +2%

Structural Fill Under Footings: ..... 0 to +2%

Exterior and Interior Slabs on Grade: ..... 0 to +2%

Pavements: ..... -2 to +2%

Non-Structural Areas: ..... -3 to +3%

3.6 GRADING

Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between such points and existing grades.

Round top and bottom of slopes and feather into undisturbed natural terrain. Avoid abrupt grade changes making smooth transitions from slopes to more level areas.

Grading Outside Building Lines:

Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and within 0.10' of required sub or finish grade elevations. Make minor modifications as may be necessary to provide adequate drainage.

Spread stockpiled topsoil and compact to minimum 6" depth at all areas not designated for walks, paving or structures.

Grading Surface or Fill Under Concrete Flatwork:

Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 0.5" when tested with a 10' straightedge.

Compaction:

After grading, compact subgrade surfaces to the depth and relative compaction requirements for each area of classification.

Drainage Fill:

Place filter fabric on prepared subgrade with lapped edges and end following manufacturer's instructions.

Place drainage fill material on filter fabric in layers of uniform thickness, conforming to indicated cross-section and thickness.

3.7 FIELD QUALITY CONTROL:

The Owner's Geotechnical Engineer will:

Sample and test fill material from sources designated by Contractor.

Observe and report on site preparation, excavation, placement and compaction of fill, backfill, controlled density fill or lean concrete. Such observations will include all tests deemed necessary to ascertain if the work is in compliance with specifications.

Approve methods of compaction.

Issue final report to Owner on grading, excavation and compaction work.

The Contractor Shall:

Furnish access to site and facilities for observations and testing.

Furnish and install shoring or bracing, as required by local codes and ordinances, to provide safe access to areas for Geotechnical Engineer.

Notify the Geotechnical Engineer 48 hours prior to any fill or backfill operations.

Pay costs for additional compaction, observations and tests due to non-compliance with Contract Documents based on reports of geotechnical testing and observations.

3.8 EROSION CONTROL:

Provide erosion control methods in accordance with requirements of authorities having jurisdiction.

3.9 MAINTENANCE:

Protection of Graded Areas:

Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerance.

Reconditioning Compacted Areas:

Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, re-shape, and compact to required density prior to further construction.

Settling:

Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.10 DISPOSAL OF EXCESS AND WASTE MATERIALS:

Remove excess excavated materials, trash, debris and waste materials and dispose of it off the Owner's property.

END OF SECTION 02200